

# *The National Conference*

*on* **HOSPITAL-ACQUIRED**  
*Staphylococcal Disease*

**T**HE NATIONAL CONFERENCE on Hospital-Acquired Staphylococcal Disease was held in Atlanta, Ga., September 15 to 17, 1958, under the joint sponsorship of the Public Health Service and the National Academy of Sciences-National Research Council.

The conference brought together delegates from 59 professional organizations and specialists from universities, independent laboratories, and hospitals.

In the opening address, Dr. Leroy E. Burney, Surgeon General of the Public Health Service, underscored heavily the importance of blocking hospital-acquired staphylococcal disease from invading the public environment. The threat, he said, "involves the development of antibiotic resistance and emergence of specific epi-

demical strains, with the concurrent threat to hospital populations and the community at large."

Other highlights of his address follow:

"Staphylococcal disease has rarely presented itself in modern times as a public health problem requiring an organized community attack, and not until now as a problem of national significance and growing magnitude. Only recently have the several professions involved in medical, hospital, and public health services begun to understand the dynamics of staphylococcal disease and hence to recognize our dependence upon one another for its control.

"We in the United States . . . must give the palm to our medical and public health colleagues in the United Kingdom, Canada, and

Australia for the first isolation of antibiotic-resistant strains in hospital populations, the development of bacteriophage typing as a new tool in staphylococcal research, and for the first demonstrations of the epidemiological patterns of hospital-acquired staphylococcal disease.

"The Symposium on Staphylococcal Infections sponsored by the New York Academy of Sciences in February 1956 brought together for the first time in this country much of the existing knowledge of the twin problem of antimicrobial resistance and staphylococcal infections in hospitals. Shortly thereafter, epidemiological studies began to appear, showing not only the nationwide prevalence of resistant strains in hospital populations, but the spread of such hospital-acquired infections into local communities.

"Since then, concern has mounted in research, clinical, and public health circles. In October 1957, for example, the Association of State and Territorial Health Officers recommended that the Public Health Service seek funds to expand its technical assistance to the States on staphylococcal problems.

"In December, the American Hospital Association, through its Council on Professional Practice, appointed a Committee on Infections Within Hospitals. This committee consulted with the Joint Commission on Accreditation of Hospitals and with the Public Health Service concerning staphylococcal infections and in May 1958 issued a bulletin recommending action in hospitals and local communities. Earlier in the year, the American Academy on Pediatrics, through its Committee on the Foetus and the Newborn, issued a supplement to its standards for the management of premature and newborn nurseries, calling for special attention to staphylococcal infections.

"For the current fiscal year, Congress appropriated \$325,000 to the Public Health Service for the Communicable Disease Center's laboratory services, training, investigations, and epidemic aid in staphylococcal disease, and added \$1 million to our research appropriations for the expansion of staphylococcal research through National Institutes of Health research grants.

"Last April, I asked the American Hospital Association's Committee . . . to advise me on

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## New Agents Counter Staphylococcus

Two antibiotics were reported to be apparently effective against staphylococcal strains, at the Sixth Annual Symposium on Antibiotics, October 1958 in Washington, D. C. In 2 years of clinical trials of vancomycin, no resistant staphylococcus bacteria were encountered, according to Dr. M. M. Kirby and two colleagues of the University of Washington. They added that in 30 patients who were administered the drug in the last year results were dramatic in instances where other antibiotics had failed.

Another antibiotic, kanamycin, was presented as a highly effective bactericidal agent with a broad spectrum by researchers at the University of California and Wadsworth Veterans Administration Hospital. They described its use on 100 patients.

Also, Dr. Paul A. Bunn and Dr. Aldona Baltch of the State University of New York Upstate Medical School report in the *New England Journal of Medicine*, October 2, 1958, that kanamycin has been found "to have an inhibiting action against most staphylococci that are penicillin-resistant" in the treatment of 25 severe and acute infections in the adult.

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this problem of national action. What are the immediate needs? And how can the Public Health Service best help to meet them? These consultants agreed that:

"First, knowledge of the existing problem of staphylococcal disease and the means for its control needs to be consolidated and brought home to the medical and health professions at all levels as quickly and as impressively as possible. A national conference should be called to develop a practical plan and to stimulate State and local action.

"Second, a complete review and careful expansion of staphylococcal research should be undertaken. In this area of need, the National Institutes of Health has been busy.

"The third need expressed by my consultants was for expansion of services to assist hospitals in preventing and controlling staphylococcal disease. This cannot be done, we all know, without high-quality bacteriological and epidemiological services and very few hospitals have such services intramurally. Laboratory

identification of staphylococci, epidemiological consultation, epidemic aid, nursing consultation, and other services such as are common in State health departments—and through them, in the Public Health Service—will be needed in increasing volume as more hospitals begin to explore and control their staphylococcus problem.

“In this area, of course, the Communicable Disease Center is the Public Health Service’s right arm. Staphylococcal disease has been given the highest priority throughout the Center. The laboratory, for example, has accepted responsibility for the National Reference Center for Staphylococcus Phage Typing. Diagnostic reagents are being prepared on a large scale by the Communicable Disease Center. Also, its Epidemic Intelligence Service physicians and nurses have been working full time on epidemiological studies in response to increasing requests for help. Training courses for laboratory workers are being developed and a wide variety of new training aids are being prepared. We expect that all of these services will be expanded rapidly as the national program gains momentum.”

As the conference progressed, the participants scanned all facets of the hospital-acquired disease. They took inventory of current knowledge by presenting papers during general sessions, and by open discussion in three small groups, assigned respectively to nursery, surgical, and general medical activities in the hospital. Finally, the delegates framed a set of recommendations which Dr. Burney hoped would be “accepted as ‘marching orders’ for every group concerned with sick and healthy people in this campaign against staphylococcal disease.”

Appearing in this issue of *Public Health Reports* are the conference recommendations, Dr. Harry F. Dowling’s résumé, and a paper on the community aspects of hospital-acquired staphylococcus infection by Dr. Frederick H. Wentworth and associates. Dr. R. E. O. Williams’ report on the staphylococcus situation in Great Britain appeared in the November 1958 issue, p. 961.

The full proceedings of the conference were published in October 1958 by the Communicable Disease Center for distribution to hospitals, medical societies, and health departments.

## Synthesis of Recommendations

### General Recommendations

The conference accepts hospital-acquired staphylococcal disease as a serious problem of global scope. There are major difficulties in comparing the incidence of infections now being observed with that in previous years, but it is generally accepted that convincing evidence establishes the problem as a serious one and that definite action on the part of hospitals and other community agencies is imperative.

#### Communications

##### INFECTIONS COMMITTEES

It is unanimously agreed that the establishment of hospital infections committees is a sound approach to the recognition, prevention, and con-

trol of hospital-acquired staphylococcal disease. The conference endorsed the recommendations of the American Hospital Association and the Joint Commission on the Accreditation of Hospitals. The following recommendations concerning the composition, responsibilities, and mechanisms of operation of such committees deserve special emphasis.

#### Composition

The hospital infections committee should consist of active, interested members of all major hospital departments, including administrative, clinical, nursing, housekeeping, and laboratory. The committee must have complete administrative back-

ing. The chairman or coordinator of the committee must be a person of stature. It is generally agreed that the bacteriology laboratory is the area through which most information about infections should be channeled. It is recommended that a bacteriologist, pathologist, or clinician with interest in bacteriology, be a permanent member of the committee and that he or some individual be charged with maintaining the day-to-day record of infection. This person should serve as hospital epidemiologist.

It is recognized that the composition and size of the committee will vary considerably from hospital to hospital, depending upon their physical and personnel resources. The committee should make free use of small subcommittees of key people for specific assignments. It is also recommended that the local health

officer should be invited to be a consultant to the committee.

### *Responsibilities*

The hospital infections committee should have the following major areas of responsibility:

**Surveillance.** The committee should regularly collect complete data on all infections acquired within the hospital, on those occurring among recently discharged patients, and determine the presence of a problem, if one exists. These data should be consolidated into formal reports for submission to the medical staff and the hospital administrator.

**Control.** The committee should be charged with the responsibility of evaluating all phases of hospital operations pertaining to the control of infections, recommending changes, establishing appropriate patterns of antibiotic usage, and instituting epidemic control measures.

Nevertheless, this committee should in no way relieve the department heads of responsibility for making decisions and executing recommendations with reference to particular department problems.

**Education.** The committee should sponsor an educational program for all hospital personnel, presenting current concepts in the proper prevention and control of hospital-acquired infections.

It is recognized that the effectiveness of any system for dealing with hospital-acquired infections will depend upon a continuing, active program directed to all professional and nonprofessional groups.

### *Mechanisms of Operation*

Mechanisms of operation will vary considerably in the individual institutions. Frequent and regular meetings of the committee are essential to maintain a high level of interest. One of the measures of effectiveness of the committee will be the thoroughness with which advice is implemented into action. Determination of the effectiveness of the committee should rest primarily with the committee and the medical staff, and not with possible inspecting agencies.

Ample emphasis should be placed on surveillance, since the major defect in delineating the staphylococcal

problem is the lack of uniformity in recognizing and reporting staphylococcal disease. Of the several methods of surveillance considered at this conference, routine culturing of all infections received the most support. In applying this method, culture results are routinely reported to the hospital infections committee for investigation, review, and classification. The final classification of each case should include the committee's determination as to whether or not the infection was acquired in the hospital. Surveillance of this type may be facilitated by the utilization of a standardized reporting form.

### INTERHOSPITAL

Because patients acquiring infections in one hospital may subsequently be admitted to another and because of the frequent interchange of personnel among hospitals, interhospital communications are essential to infections control. Such communications might be developed by establishing infections committees in the local medical societies, with representatives from the hospitals in the area. Interhospital communication might also be achieved by the addition of members of the staffs of other hospitals to the membership of the hospital infections committee.

### HEALTH DEPARTMENT

The health department can be of considerable help to the hospital in controlling infections by providing laboratory services, epidemiological consultation, and assistance with surveys of illness among discharged patients. To attain optimal communications between hospitals and health departments, the health officer should be made a consultant to the hospital infections committee.

### OFFICIAL REPORTING

Official reporting of staphylococcal diseases is difficult because of the ubiquity of minor community-acquired staphylococcal infections. No specific recommendation concerning voluntary or compulsory reporting of staphylococcal diseases is made. Some delegates felt, however, that mandatory reporting of staphylo-

coccal disease during the first 6 weeks of life might be helpful. Diseases in this age group to be reported might include pyoderma, breast abscess, empyema, and osteomyelitis. Other conferees feel that it is feasible to report all staphylococcal infections provided the reporting forms are simple. In some States, staphylococcal disease is now notifiable. The reporting programs of these States warrant careful evaluation.

### Patient Care

#### ADMISSION POLICY

It is known that some patients are more susceptible to staphylococcal disease than others. Since hospitals may represent a significant reservoir of staphylococcal infections, individual hospitals should reconsider their admission policies regarding highly susceptible patients. In many instances, these patients might be better managed in the home.

Patients with staphylococcal disease requiring hospitalization should be recognized as a potential danger and proper precautions instituted at the time of admission.

#### ISOLATION

Infected patients are a major source of hospital infections. Ideally, all infected patients should be placed in strict isolation. This ideal is often unattainable. Priority then should be given to isolating those who are most likely to spread infection to others; for example, patients with pulmonary staphylococcal infections or with exposed foci of suppuration. In addition, it is advisable to isolate certain patients who are especially susceptible to staphylococcal infections, such as those with extensive burns or exfoliative dermatitis.

The transportation of patients with staphylococcal infections from one area of the hospital to another, while often necessary, may be dangerous. It is recommended that these patients be covered with sterile sheets during transport. Careful cleaning and disinfection of the areas in which they have been examined or treated should be a routine procedure.

It is becoming increasingly apparent that techniques of isolation have fallen into disuse and are unfamiliar to both professional and nonprofessional personnel. Consequently, as practiced, they are often ineffective. It is strongly recommended that the hospital infections committee carry out continuing programs of education in isolation procedures. (See the section on hospital sanitation for recommendations on sterilization, disinfection, and hospital design).

### DIAGNOSIS AND THERAPY

Certain techniques formerly considered minor, such as venipuncture, intravenous cannulation, clysis, catheterization of the urinary bladder, and aspirations of body cavities, indeed all procedures which interrupt the normal skin barrier, may produce important portals of entry for staphylococcus infections. It is recommended that these procedures should be kept to a sensible minimum and always be performed with strict asepsis.

The conference considered both the general problems of antibiotic therapy within the hospital and the application of antibiotic prophylaxis to the control of infections.

#### *General Antibiotic Usage*

There was unanimous condemnation of the indiscriminate use of antibiotics and acceptance of the need for plans to govern their judicious usage. No single plan has yet been found to be satisfactory for application in all types of hospitals and therefore specific recommendations cannot be made. It is urged, however, that hospital infections committees give priority to a study of this problem and design an orderly approach to meet their own needs.

#### *Antibiotic Prophylaxis*

With certain exceptions, antibiotic prophylaxis to prevent staphylococcal infections has not proved to be a useful or desirable procedure, and it is not recommended.

One exception to this recommendation may be made in the nursery epidemic situation where antimicrobial prophylaxis against the specific epidemic strain may be the method of choice for the interruption

of an epidemic (see Specific Recommendations, Nursery). Other exceptions may be made for certain types of patients who are at special risk. In these cases, antibiotics should be used only after careful deliberation by a group or committee concerned with the problem.

It is unanimously agreed that prophylactic antibiotics do not prevent staphylococcal infections in clean surgical wounds, but that they may tend to mask or attenuate the appearance of the infections. It should be emphasized that the most important points in surgical wound management, whether the wounds are operative or traumatic, are asepsis and meticulous, careful technique, combined with the removal of all devitalized and contaminative foreign material, and closure of tissues with maintenance of an adequate blood supply.

### Hospital Sanitation

The widespread occurrence and hardy nature of the staphylococcus stimulated considerable discussion of the importance of high standards of environmental sanitation. The recommendations are grouped into those concerning hospital design, ventilation, housekeeping procedures, and sterilization and disinfection.

### HOSPITAL DESIGN

Basic to the effective application of aseptic technique is the provision of proper equipment and space allocation for their implementation. Certain deficiencies in hospital design are becoming apparent, but because present knowledge does not permit definitive recommendations about changes in hospital architecture, caution must be exercised before undertaking extensive building alterations in the hope that they might limit staphylococcal disease within hospitals.

On the other hand, it is recommended that hospital administrators seriously consider such alterations as are necessary to bring existing facilities up to standards currently recommended by the American Academy of Pediatrics, the American Hospital Association, and State and local health departments.

In addition, scientifically controlled research studies should be conducted to determine, for example, the optimal design for newborn nurseries and to demonstrate the validity of minimum standards currently recommended for the elimination and control of cross-infection.

### HOSPITAL VENTILATION

Cognizance was taken of the many studies describing a reduction of the concentration of bacteria in the environment following the installation of various types of ventilation equipment. It is agreed, however, that these methods have not been adequately evaluated in terms of their specific effect upon the prevention of infection. No recommendations concerning changes in existing ventilating systems were made, but it was suggested that proper cleansing and maintenance of air conditioning systems now in operation should be a routine hospital housekeeping procedure.

### HOUSEKEEPING PROCEDURES

There is growing evidence that poor housekeeping techniques contribute to the dissemination of hospital-acquired staphylococcal infections. It is agreed that effective housekeeping demands constant vigilance on the part of both the administrative and professional staff and can be effectively accomplished only when all groups give due recognition to this aspect of disease control. It is recommended that the hospital infections committee periodically evaluate all parts of the housekeeping routine, giving special attention to adequate dust control, acceptable techniques of floor cleaning, sterilization of equipment, and laundry procedures.

As recent studies have focused attention on the laundry and its role in the dissemination of infection, it is recommended that great care be given to insure that contaminated linen and blankets, particularly from patients with staphylococcal disease, not be mixed with other laundry, that contaminated trucks not be used for transporting clean laundry, and that clean and dirty laundry never be transported concurrently. Evidence suggests that

sheets, blankets, and mattresses may play a role in the spread of infection, and thus deserve special attention.

Patients admitted to the hospital should be furnished with clean blankets, sterilized linens, and clean mattresses. Cleanliness of mattresses may be approached through the use of disposable or nondisposable plastic covers.

### STERILIZATION

Because sterile technique is so fundamental to the prevention of hospital-acquired staphylococcal disease, techniques of sterilization and disinfection require constant attention and reevaluation. Meticulous checks, both thermal and bacteriological, on the effectiveness of ordinary methods of sterilization should be routinely carried out. The need for sterilization of certain kinds of equipment, such as stethoscopes, ophthalmoscopes, and sphygmomanometers, should be reconsidered.

### Personnel Carriers

Carriers of staphylococci among hospital personnel present one of the more difficult problems in the control of hospital-acquired staphylococcal infections. There are really two problems here. The first is the individual with a frank lesion, the other is the inapparent carrier who is without overt lesions.

### FRANK INFECTIONS

It is strongly recommended that hospital personnel, including physicians, nurses, and others, who develop frank staphylococcal lesions should be excluded from duty until the lesions are healed. It is further recommended that:

- A continuous program of education of all personnel emphasize the hazard of staphylococcus lesions to the welfare of the patient.

- Personnel be required to report the presence of lesions to a central clinic or to a designated physician.

- All reported lesions receive prompt diagnosis and therapy.

- A policy be adopted to prevent financial loss to personnel who are barred from duty because of frank lesions.

- During an epidemic or period of

increased incidence of staphylococcal disease, active search be made for the presence of lesions among the personnel. Such a program can be appropriately directed by the infections committee. In searching for carriers, a thorough physical inspection should be made to detect those who may have hidden but dangerous lesions; for example, in the axilla, buttocks, and perineal region.

### THE INAPPARENT CARRIER

The majority of hospital personnel may be shown at one time or another to be carrying coagulase-positive staphylococci on their skin or mucous membranes. It must be stressed that most of these carriers are not hazardous to the patients, because they either disseminate very few staphylococci or the particular strain of organism which they are carrying is of low transmissibility or pathogenicity, or both. The mere presence of coagulase-positive staphylococci, therefore, is not grounds for removal of a carrier nor does it constitute an indication for antibiotic therapy. Thus, routine surveillance for carriers is not recommended.

During an epidemic or increased incidence of disease, it is essential that a thorough search of all personnel be made for carriers of epidemic strains associated with the

outbreak. The usually accepted method for finding carriers is restricted to nasal or nasopharyngeal culture surveys of the personnel. In instances where carriers of epidemic strains are not found by this technique, it might be helpful to extend the examination of personnel to other potential portals of exit, such as the hair, throat, perianal skin, and stool.

Carriers of epidemic strains associated with the outbreak should be considered "dangerous carriers" and should be removed from duty. Many carriers, even the temporarily dangerous ones, will cease to carry the epidemic strain upon their removal from the contaminated environment. The status of the individual carrier must, therefore, be periodically evaluated and after his reversion to negative, he should be returned to duty.

When an epidemic strain persists in a carrier, his permanent removal from duty must be given careful consideration. Such victims should receive assistance in the form of new job training.

Many substances such as antibiotic nasal jellies and sprays have been used both for the prophylaxis and for local treatment of carriers. The conference is unable to recommend any of these procedures at the present time but urges their evaluation.

## Specific Recommendations

In addition to those recommendations which apply generally to the detection and control of hospital-acquired staphylococcal disease within the hospital, the conference has made certain recommendations which apply specifically to a particular service within the hospital.

### Nursery

#### DISCHARGED INFANTS

It is characteristic of staphylococcal disease in newborn nurseries that the vast majority of infants do not develop lesions until after they have been discharged from the hospital. In order that the hospital may become aware of a staphylococcal problem within the nursery as early as

possible, some method needs to be devised for detection of infections among the discharged infants. Several methods have been used for this purpose: telephone surveys, questionnaire surveys, routine visits by public health nurses, or culture surveys of infants at the time of discharge. The conference generally recommends the telephone survey as being most desirable in epidemic situations because of its efficiency, promptness, and ease of administration. However, all of the methods enumerated have been shown to be effective in some communities, and the hospital infections committee should decide which one to use after consultation with other community

agencies, especially the medical society and health departments.

It is generally recommended that surveys of discharged infants be carried on by the hospital, but it is recognized that in many communities the health department can assist with or can conduct the survey.

Surveys of this kind can obviously be conducted on either a periodic or continuous basis. Some hospitals carry on continuous surveys as part of their general disease surveillance program. Other hospitals conduct periodic surveys. Often a routine sampling of a portion of discharged patients is satisfactory. It is strongly recommended that all hospitals institute some type of survey procedure.

#### ANTIBIOTIC PROPHYLAXIS

In some instances, nursery epidemics appear to be self-propagating and result in a high incidence of colonization or frank disease among the infants due to an epidemic strain of high virulence. In such situations, it is possible to protect infants from colonization by administering an effective antibiotic in full therapeutic doses to all infants beginning immediately after birth and continuing until after discharge. Antibiotic prophylaxis of this type effectively prevents colonization of the infant's nose and thus his skin and allows time to search for dangerous carriers among the personnel, and to locate and correct breaks in aseptic technique. Antibiotic prophylaxis should be used only after very careful evaluation of the situation, preferably by the infections committee, and should never be used for prolonged periods nor be used on a continuous basis.

#### PERIODIC CULTURING

Available evidence suggests that specific strains of staphylococci which can be detected by phage typing are capable of producing nursery epidemics. In contrast with the other services in the hospitals, therefore, it may be profitable to survey the nursery personnel periodically in order to detect carriers of these particular strains. Such surveys should be undertaken routinely only in well-equipped hospi-

tals and should be considered as combined research and control procedures.

### Surgery

#### OPERATING ROOMS

Separate operating rooms for clean and "dirty" surgical cases are not recommended. Rather, all operating rooms should be cleaned between operations and meticulously so after an operation on a contaminated case. The same meticulous care must be applied to sterilizing contaminated linens, instruments, and operative clothing.

#### SCHEDULING OF OPERATIONS

It is recommended that "dirty" surgical cases be placed at the end of the operating schedule.

#### OPERATING ROOM TECHNIQUE

The entire operating room team must be constantly alert for breaks in technique. Excessive talking (chatter) has no place in the operating room. Operating room clothing must not be worn outside the operating suite. Caps and masks must be changed between each operation. All visitors to the operating room must change completely from street clothing before entering.

#### SURGICAL DRESSING TECHNIQUE

Every effort should be made to minimize cross-infection through contaminated dressing carts and faulty dressing care.

#### PERSONNEL CARRIERS

Personnel found to be carriers of coagulase-positive staphylococci of any type should be allowed to continue on duty in the absence of an increased incidence of surgical wound infections. Even when a problem does exist, the removal of carriers should be delayed until one is certain that all other possibilities, such as defects in sterilization, have been ruled out. The one exception to this general policy is the nurse or physician who is known to be a carrier of an epidemic strain and comes from a service where there has been or is a problem.

While these recommendations apply to the inapparent carrier, it is strongly recommended that all per-

sonnel with frank staphylococcal lesions remove themselves from the surgical suite until the lesion is healed.

### Medical Services

Distinct differences in the pattern of staphylococcal infections on medical services as contrasted with surgical and pediatric services are recognized. Nevertheless, it is agreed that a substantial staphylococcal infection problem exists on medical services also and the need for constant attention to aseptic techniques and control measures is just as imperative here as elsewhere. This need is important not only to prevent infections among medical patients, but also because of extensive commingling of patients among services to control spread of disease throughout the hospital.

### Laboratory Services

#### INITIAL ISOLATIONS

Bacteriological services of a high caliber are essential to the diagnosis and therapy of staphylococcal disease and to the detection and control of hospital-acquired staphylococcal infections. It is recommended that hospitals throughout the country include in their laboratory programs the initial isolation of staphylococci, coagulase testing, and antibiotic sensitivity testing. It is recognized that there is presently a certain amount of unreliability with the disk method of antibiotic sensitivity testing, but it is noted that the Food and Drug Administration is presently adopting standards in an effort to correct these defects. While the serial tube method is admittedly more accurate, it is considered to be too time consuming and expensive for routine use. Therefore, most hospital laboratories must resort to the disk method for establishing the antibiotic sensitivity of staphylococci.

#### SPECIFIC DIAGNOSIS

Bacteriophage typing is not practical in most hospital laboratories at the present time, but specific diagnostic services should be available when needed. While there is little routine need for such serv-

ices, they are essential to the detection of sources of nursery epidemics and their control; and are helpful in the control of outbreaks or in other services. However, it is strongly recommended that hospital laboratories adopt some systematic method of saving isolates of staphylococci from infected individuals, so that in

the eventuality of an outbreak, it will be possible through bacteriophage typing to trace the events that led to the epidemic. Policies concerning the length of time cultures should be saved and the selection of strains for bacteriophage typing can appropriately rest with the infections committee.

## METHODS MANUAL

Although much useful information regarding adequate sterilization and disinfection procedures has been published, it is currently scattered in many relatively inaccessible publications. It is recommended, therefore, that all available information on sterilization of special equipment, environmental disinfection, and the most recent methods of sterilization be collected in readily available manual form and distributed by the Public Health Service or some other appropriate agency.

## Special Recommendations

In addition to the recommendations which have been made for the hospital and hospital services, the conference has made certain special recommendations concerning the provision of certain services and the request for assistance from certain agencies.

In addition, the committee should be requested to provide a classification and grading of infections which could be used as a guide by individual hospitals in their surveillance programs.

### TERMS AND CLASSIFICATION

An ad hoc committee on the terminology and classification of staphylococcal disease should be established. It is agreed that considerable confusion exists because of the lack of agreement in the use of such terms as apparent and inapparent infections, disease, sepsis, clinical or subclinical infection, and asymptomatic carrier. Many difficulties result from attempts to compare data in published reports that fail to distinguish the carrier state from colonization and disease or sepsis. It is strongly recommended that a subcommittee be formed to define terminology that will clearly differentiate these various terms and clarify the vocabulary applicable to staphylococcal diseases.

### EDUCATION AND TRAINING AIDS

The conference recognizes the need for education and training aids to support the national program necessary for the control of staphylococcal infections in hospitals. It is strongly recommended, therefore, that the chief of the Communicable Disease Center ask appropriate interested organizations, including the American Hospital Association, the American Medical Association, and the American College of Surgeons, to designate representatives to form an interagency clearinghouse or coordinating committee for educational materials, such as audiovisual aids and literature. Such a committee, by joint sponsorship, would encourage the production of the best possible material, would avoid unnecessary duplications, and would keep all concerned aware of activities in this field.

### HOSPITAL VENTILATION

Because aerial dissemination of infection may play an important role in the transmission of hospital-acquired staphylococcal disease, there is a need for a correlation of information by the medical, epidemiological, and engineering professions. Therefore, the Public Health Service is encouraged to arrange a conference of interested representatives of these professions to examine the whole problem and develop sound standards.

### LABORATORY MANUAL

Attention is called to the fact that the Communicable Disease Center Laboratory in Atlanta, Ga., has recently assumed the responsibility of providing reference laboratory services for bacteriophage typing. A manual of acceptable procedures for the precise identification of staphylococci has been produced with the assistance of a subcommittee of this conference.

## In Résumé

We have hammered out the many things that we know and that we do not know about staphylococci. We know the cultural characteristics of the organisms, their prevalence in hospital patients, hospital personnel, and persons outside of hospitals, and the frequency with which they are found in the hospital environment. We know how, roughly, to determine whether a strain is potentially pathogenic, how

to identify individual strains, and how to trace their spread from person to person. We do not know how to determine the invasiveness of an individual strain, nor its pathogenicity, with certainty, nor its virulence. We do not know how to prevent the spread of staphylococci from one part of a person's anatomy to another, nor from one person to another person.

We know the prevalence of strains of staphy-

lococci which are resistant to various antibiotics in different populations, and we know some of the factors that cause resistant strains to appear; we don't know how to prevent the appearance of such strains in hospitals (short of exposing no one at all to that particular antibiotic), and we don't know how to replace a resistant strain with a sensitive one.

We know that staphylococci are spread among patients and personnel of hospitals, that they may cause endemic infections in any hospitalized patients and epidemics chiefly among newborns and surgical patients. We don't know the most frequent pathways of spread, whether carriers or environmental sources are the most important, nor what makes epidemics start. We know that certain strains are more frequently encountered as epidemic strains; we don't know what causes them to become epidemic strains. We can often trace an epidemic to an infected person or carrier; we cannot tell why some other infected person or carrier did not start an epidemic. We know that the removal of a carrier or strict attention to aseptic techniques sometimes appears to stop an epidemic; we fear that these measures will not always do so.

We know some conditions that increase patients' susceptibility to staphylococcal infections, but do not know why some persons develop staphylococcal infections while others fail to do so under apparently identical circumstances. Finally, especially as a result of this conference, we don't know any cause for wild alarm and gnashing of teeth over the staphylococcal problem; we do know that there is an important and compelling job to be done which calls for rolling up our sleeves and getting to work.

### **Techniques of Control**

How should we go about controlling staphylococcal infections? Since we cannot easily get rid of the staphylococci that are causing or may cause disease within a hospital, most recommendations in the discussions were directed at limiting their spread. The first barrier is at the entrance of the hospital or the ward. Perhaps some patients with staphylococcal infections could be better nursed at home. Hos-

pital personnel, from the chief of staff down, should not contact patients if the staff member has a staphylococcal skin lesion or is known to have produced infections in patients. During an epidemic in a critical area such as a nursery or an operating room, personnel may be removed if they are carrying the epidemic strain.

The second barrier is within the hospital, between personnel and patient or between patient and patient. The conferees unanimously recommended complete isolation of patients with staphylococcal infections, wherever practicable. They urged that careful techniques be observed in the performance of operations, along with the proper sterilization of instruments and apparatus, the proper technique in dressing wounds, careful disposal of discharges and sputum, the washing of hands after examining patients with infected lesions, and the removal of staphylococci from that susceptible animal, the newborn infant, by washing his skin with special preparations.

With regard to spread through the air or from objects in the environment, everyone recognized the need for more knowledge. We do not know enough about the importance of proper ventilation (except in the operating room and rooms for dressing wounds), of washing floors and walls, of sterilizing blankets, of spacing beds and cribs; we do not know the value of rooming-in procedures for infants and so on. It was emphasized again and again that there is no simple and easy panacea for the control of intrahospital staphylococcal infections. Many things must be done, some of which may be unnecessary; the wisest course is first to close the most likely pathways of spread of infection and proceed to the others if necessary. In the last extremity, nurseries or wards may be closed, and, almost everyone agreed, the operating room might have to be closed, too.

Antibiotics, which have no doubt been responsible for some of our trouble with the staphylococci, are of little help in getting us out of trouble. Their role in the prevention of infections is limited to certain specific situations. There is no evidence that they will prevent staphylococcal infections from developing in hospitalized patients except perhaps

when the staphylococcus causing an epidemic in a nursery is sensitive to a specified antibiotic. The surgeons even differed as to whether the poorly absorbable antibiotics should be administered prior to bowel surgery, although they did agree that antibiotics will not prevent infections from developing in clean surgical wounds. The suggestion was made that spraying of the noses of carriers may eliminate the carrier state in some persons, but it was recognized that more study is needed in this area.

Of course, a most important means of control is to eliminate the infection at its source, in other words, to treat the patient who has a staphylococcal infection. This requires the highest degree of skill and knowledge on the part of the clinician to diagnose the disease properly, to interpret the tests run by the supporting laboratory, to choose the proper antibiotic from among the number at hand today, and to administer it properly. When the clinician is not sufficiently familiar with this area, he should not hesitate to call for advice.

#### **A Reporting System**

Infections cannot be controlled unless we know that they are there. This requires reporting of staphylococcal infections by certain responsible parties within each hospital. The initial report has been made in different hospitals by house officers, nurses, or personnel in the hospital laboratory. Different methods may be feasible for different hospitals. Whichever one is used, the reports should go to an infections committee, which should be set up in each hospital. Such a committee should be

broad in its interest, representative in its personnel, and of sufficient authority to make sure that its suggestions will be carried out.

Reporting should be amplified by checkups of susceptible groups, such as newborns, after they have left the hospital. Several feasible methods were suggested for these surveys. Most important is that they have the full cooperation of the hospitals, of the medical profession, and of the health officer.

Reporting and control are not successful without proper definitions. Agreement could not be reached on any one system of classification of staphylococcal infections. Accordingly, it was suggested that the Public Health Service set up a committee to recommend a proper classification.

None of the measures for control will have any effect without continuous, interesting, and authoritative publicity. Educational programs are needed within the hospital for all the personnel from the lowest to the highest. These can be aided by health authorities and local and national medical associations by the provision of information, teaching aids, and speakers, and the initiation of communitywide meetings from time to time.

Finally, and most urgently, we need more research on staphylococci and the infections they cause. I have already mentioned some of the things we need to know. Funds are needed for intramural and extramural research on the practical problems of staphylococcal infections, their communicability and control, and especially on fundamental problems of host resistance to the staphylococcus and how it may be strengthened.

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# Hospital-Acquired Staphylococcal Disease and the Community

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**H**OSPITALS provide vitally needed services to practitioners of medicine and to the community at large. Anything which tends to disrupt hospital services or interfere in any way with their optimal function is of real concern to the community. Hospital-acquired staphylococcal disease can certainly decrease the efficiency of hospital operation by prolonging the patient's hospital stay, increasing the cost of medical care, and, in some cases, jeopardizing the patient's recovery. The community and community agencies may be expected for these reasons to be vitally interested in the control of the problem.

Recent studies of the epidemiology of hospital-acquired staphylococcal infections have established additional reasons for concern. It is now very clear that the hospital with an uncontrolled staphylococcal disease problem may act as a focus of infection for the community itself. It is also clear that many patients infected while in the hospital do not develop overt disease until some time following their discharge and thus the detection of the disease in the community becomes essential to the delineation of the hospital problem and its control. Evidence supporting these concepts is at the

moment most convincing in the case of strain-specific staphylococcal infections acquired in hospital nurseries.

Two outstanding features of the epidemiology of nursery outbreaks have been the number of infants who develop the first signs of disease following discharge from the hospital and the frequency of postpartum breast abscess among mothers. Studies on the nasal flora of women on admission to the maternity service and at the time of discharge, as well as that of their infants, indicate the infants (1) are the source of the staphylococcus responsible for the breast abscesses. These studies also demonstrated that in the vast majority of cases transmission from infant to mother takes place in the home. These findings suggested the possibility of simultaneous or subsequent transmission to other members of the family and the establishment of endemic staphylococcal disease within the family group.

Colbeck, while studying nursery outbreaks in Winnipeg in 1949, found this to be the case (2). In the families of 10 infants born in an epidemic period, he demonstrated recurrent suppurative disease among family members during several months following the discharge of the infant and mother from the hospital. Staphylococci isolated from the lesions in family members appeared to be of the same phage type as that responsible for the nursery outbreak. In 1953 Kempe, reporting the family as a reservoir of childhood infections, includes an excellent description of family staphylococcal disease persisting over a 9-week period (3). More recently we have studied the families of

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26 infants infected with the epidemic phage type 80/81 during a nursery outbreak (4). During 5 months of observation about three-fourths of the mothers and one-third of the fathers and siblings were shown to be carrying phage type 80/81 in their nasopharynx on one or more occasions. Eleven of the 26 families were still infected at the end of the study. A variety of skin infections and subcutaneous abscesses occurred in about 40 percent of the infected mothers and fathers and 70 percent of infected siblings. Shaffer and associates have reported similar findings (5). At the end of the 18 months of his study, 9 of 20 families were still infected.

These investigations have provided convincing evidence that epidemic strains of staphylococci carried by infants at discharge are rather readily transmitted to family members, persist for long periods within the family, and are responsible for endemic staphylococcal disease within the family unit.

Further evidence that the nursery epidemics may result in an increased incidence of community disease has been provided by a comparison of families of infants born during epidemic and nonepidemic periods in the same hospital. In one recent study, investigations were made of 1,076 families of infants born during a nursery epidemic of 3 months' duration and 211 families of infants born during a nonepidemic period (6). In 25 percent of the families of epidemic infants one or more members of the family group had developed staphylococcal disease 1 to 5 months following the birth of the baby, while 3 percent of families of nonepidemic infants gave a similar history. Eleven percent of 3,975 family contacts developed disease during the epidemic period, while 0.8 percent of 506 family members developed a similar illness during the nonepidemic period. If an infection rate of about 1 percent is accepted as a rough approximation of the level of endemic community disease during this period, then the difference between this and a rate of 11 percent is an approximation of the magnitude of increase in community infection which resulted from the nursery epidemic.

If the magnitudes expressed here are reasonably accurate and representative, it follows that

a significant increase in the level of community staphylococcal disease will follow uncontrolled type-specific nursery outbreaks. We are unaware of systematic studies of the transmission of epidemic strains from these hospital-associated families into the general community, but fragmentary evidence suggests this to be the case. Certainly the persistence of the strains within the family unit for such long periods make it likely that transmission to friends and relatives will eventually occur. In this event the "crude equilibrium between the public at large and the ubiquitous staphylococci" referred to by McDermott as appearing relatively stable in 1956 (7) might well be shifted in favor of the staphylococcus and result in an absolute increase in the level of endemic community disease.

It is difficult for one who has not observed family staphylococcal disease to be impressed with the seriousness of the situation. We observed one family whose infant was born in October 1954 in a nursery during an epidemic caused by phage type 80/81. The infant developed a few blebs prior to discharge and severe staphylococcal impetigo after he went home. Since then this family has virtually never been without staphylococcal disease in 1 or more of its 5 members. The father and 1 of the 3 children have been hospitalized for incision and drainage of abscesses. The two other children and the mother have had incision and drainage as outpatients. On three different occasions the entire family has been treated with antibiotics in an attempt to eradicate the family infection. It is conservatively estimated that the cost in antibiotics and medical care, exclusive of hospitalization, has been well in excess of \$1,500. Type 80/81 has been repeatedly isolated from the nasopharynx and lesions of these individuals and was last isolated in July 1958, nearly 4 years after the epidemic.

The history of another family has been related to us by their private physician. He has been attempting to eradicate type 80/81 from this family for well over a year. In this case there had been no recent direct hospital contact. Two siblings had vacationed for a month with an uncle who had been having recurrent boils and carbuncles for a year, his problem

having started shortly after he was discharged from the hospital following elective surgery. The 80/81 strain was isolated from his lesions, and the hospital in which he had surgery was found to have a staphylococcal disease problem.

Although not representative, these cases illustrate the extent to which infection may become a serious problem for the family and point up the very great difficulties of eradicating the infection from the family group. Treating the family as a unit with an appropriate antibiotic appears to be effective in some instances, but by and large results in failure. According to a personal communication in 1958, Colbeck has had some encouraging results following thorough disinfection of the household. It is probably fair to state, however, that at the moment there is no really satisfactory approach to the eradication of the epidemic strains from the family and that, in a good percentage of the cases, staphylococcal disease may be expected to recur over long periods despite repeated attempts at eradication.

These findings certainly underline the importance of controlling nursery outbreaks. In addition, they have certain practical implications. During nursery epidemics it is not unusual for the majority of infants to develop their disease following discharge from the hospital. The number of cases of frank disease occurring in the nursery are frequently below the threshold of recognition. Unless the infants developing postdischarge disease are properly diagnosed and reported back to the hospital, an epidemic situation may continue undetected for long periods. This implies that the prompt detection and control of hospital epidemics requires the cooperation of individuals and agencies outside the hospital. The adequate provision of laboratory services, a reporting system, and survey techniques for the detection of lesions unattended or unreported by physicians are essential to the control of the hospital situation. With respect to nursery outbreaks, then, the universe of concern clearly extends beyond the hospital walls and includes the entire community of which the hospital is a part.

Whether these findings apply to the post-surgical infections of the hospital-infected adult medical patient is less clear. It has been

shown repeatedly that hospital patients acquire antibiotic resistant strains of staphylococci during their hospital stay and are carrying them on their skin or mucous membranes at the time of discharge (8, 9). Some degree of transmission to family members of nonepidemic "hospital strains" resistant to antibiotics has been demonstrated (8), but the seriousness of a potential increase in the endemic level of community staphylococcal disease needs further exploration. Infections with antibiotic resistant strains certainly present more difficult therapeutic problems and appear to be resulting in a higher case fatality rate than infections with sensitive strains (10, 11). As the hospital is a primary community source of antibiotic resistant staphylococci, hospital-acquired staphylococcal infections are a threat to the community. While the role of official public health agencies and an organized community in the detection and control of these infections is less clear than in the case of nursery disease, the need for community interest and awareness and the responsibility of community agencies for the provision of service to assist the hospital is surely as great.

In summary, it would appear fair to state that hospital-acquired staphylococcal disease is a hazard to the community because it threatens the efficiency of hospital operation and because, at least in the case of type-specific nursery disease, acts as a focus for a serious increase in the level of community-acquired staphylococcal disease. In addition, it is likely that hospital epidemics may go undetected unless the hospital-acquired disease occurring after discharge is promptly found and brought to the attention of the hospital. Organized community effort to provide epidemiological and laboratory services, the prompt reporting and analysis of incidence data, and surveys for hospital-associated morbidity undetected by other means are essential to the control of hospital epidemics.

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## Nursing Opportunities in the Public Health Service

Staff nurses, head nurses, and supervisors are employed in 16 major Public Health Service hospitals in the United States and in 55 Public Health Service Indian and Alaska native hospitals. Clinical nurses are also employed in the Clinical Center, the Service's 500-bed research hospital at the National Institutes of Health. Twelve of the 16 hospitals provide general medical and surgical services; 1 is exclusively for tuberculosis cases; 2 are for treatment of narcotic addiction and other neuropsychiatric disorders; and 1 is the only hospital in continental United States devoted exclusively to care of leprosy patients. There are opportunities for teaching and training at all levels.

Total bed capacity of the 16 major hospitals in the United States ranges from 135 to 1,250 beds; the total capacity in the Indian and Alaska native hospitals is about 3,800, with bed capacity per hospital ranging up to 400.

In the field of public health nursing, opportunities are available in epidemiological investigations and studies, in public health activities in the Indian health program, in general and special public health programs (such as heart disease control, tuberculosis control, venereal disease control, and quarantine activities), and in technical assistance programs overseas.

Entrance salaries for Public Health Service professional nurses were recently raised by 10 percent. They now range from \$4,040 a year for GS-5 beginners (formerly \$3,670) to \$9,890 for GS-13 program heads (formerly \$8,990). For nurses with a year of experience, the new rate is \$4,490 a year (formerly \$4,080).

Further information on nursing opportunities may be obtained by writing to the Surgeon General, U. S. Public Health Service (P), Washington 25, D. C.